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14. ABSTRACT

The Department of Homeland Security - Science and Technology Directorate (S&T) has partnered with FEMA to investigate and assess new technologies and processes for an updated Homeland Security Exercise and Evaluation Program (HSEEP) Enterprise Platform (EP) for operational use. HSEEP is a capabilities and performance-based exercise program which provides a standardized policy, methodology, and terminology for exercise design, development, conduct, evaluation, and improvement planning. An integral part of HSEEP was the development of the HSEEP Toolkit, a web-based collection of tools for exercise scheduling, design, development, evaluation and Improvement planning. The current HSEEP toolkit does not facilitate information sharing or provide a seamlessly integrated exercise support system. In order to effectively update the capabilities of this HSEEP toolkit, an exhaustive assessment was performed that focused on: new system requirements; translation or the new system requirements and the results of an initial operation analysis into an improved HSEEP toolkit prototype aimed at exercise support; and the incorporation or science-based information and data via modeling and simulation (M&S) capabilities into the HSEEP exercise cycle.

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***Abstract*— The Department of Homeland Security – Science and Technology Directorate (S&T) has partnered with FEMA to investigate and assess new technologies and processes for an updated Homeland Security Exercise and Evaluation Program (HSEEP) Enterprise Platform (EP) for operational use. HSEEP is a capabilities and performance-based exercise program which provides a standardized policy, methodology, and terminology for exercise design, development, conduct, evaluation, and improvement planning. An integral part of HSEEP was the development of the HSEEP Toolkit, a web-based collection of tools for exercise scheduling, design, development, evaluation and improvement planning. The current HSEEP toolkit does not facilitate information sharing or provide a seamlessly integrated exercise support system. In order to effectively update the capabilities of this HSEEP toolkit, an exhaustive assessment was performed that focused on: new system requirements; translation of the new system requirements and the results of an initial operations analysis into an improved HSEEP toolkit prototype aimed at exercise support; and the incorporation of science-based information and data via modeling and simulation (M&S) capabilities into the HSEEP exercise cycle.**

Keywords-HSEEP, exercise planning, architecture, modeling and simulation.

I. INTRODUCTION

The Department of Homeland Security – Science and Technology Directorate (S&T) has partnered with FEMA to investigate and assess new technologies and processes for an updated Homeland Security Exercise and Evaluation Program (HSEEP) Enterprise Platform (EP) for operational use. HSEEP is a capabilities and performance-based exercise program which provides a standardized policy, methodology, and terminology for exercise design, development, conduct, evaluation, and improvement planning. [1] The DHS FEMA National Exercise Division (NED) has developed several custom software systems and associated information technology infrastructure to support the National Exercise Program and the HSEEP methodology (Figure 1). An integral part of HSEEP was the concomitant development of the HSEEP Toolkit, an interactive, on-line collection of tools for exercise scheduling, design, development, evaluation and improvement planning. The National Exercise Program (NEP) [2,3] has adopted HSEEP as the standardized methodology by which all exercises are designed, developed, conducted, and evaluated. All interagency partners have adopted HSEEP as their methodology for all exercises that will be conducted as part of the NEP.

The suite of tools comprising the HSEEP Toolkit, originally designed in 2005, is not well-connected; discrete tools were developed with different software and different user interfaces. In analyzing how the HSEEP toolkit can support the NED enterprise and the HSEEP methodology, several capability gaps emerged. One major gap is a flexible and scalable enterprise architecture that translates federal policy and vision into a suite of capabilities that satisfies a diverse set of

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requirements from federal, state, local, tribal, private sector, and non-governmental stakeholders in the emergency response community. Specific capability gaps were also identified in conduct management, modeling and simulation, evaluation/assessment, and sharing of lessons learned and establishment of a community of exercise professionals. In order to effectively update the capabilities of this HSEEP toolkit (i.e. a new enterprise platform), a comprehensive assessment was performed that focused on: new system requirements; translation of the new system requirements and the results of an initial operations analysis into an improved HSEEP toolkit prototype aimed at exercise support; and the incorporation of science-based information and data via modeling and simulation capabilities into the HSEEP exercise cycle.

To create more integration and unity in the architecture, a system requirements gathering process was conducted that drew upon experience and expertise across a wide-range of exercise planners and key stakeholders at the federal, state, and local levels in addition to interagency exercise planners and subject matter experts from the FEMA National Exercise Division (NED). The system requirements in concert with the initial operations analysis will result in initial system architecture and prototypes concentrating on the assessment, scalability, and security of the HSEEP Toolkit exercise support. DHS S&T identified the need to infuse science-based information and data into the HSEEP methodology by integrating modeling and simulation (M&S) support capabilities into the HSEEP cycle.

Figure 1. HSEEP cycle.

In this presentation, we will provide an overview of the HSEEP-EP program, briefly summarize the system requirements gathering process, present an initial vision for the HSEEP-EP generic system architecture, and discuss the integration of modeling and simulation capabilities as an integral component of the HSEEP-EP.

II. HSEEP-EP Program

A. *Objectives*

The overarching objective is to develop and demonstrate an enterprise-level emergency preparedness exercise system architecture that integrates standardized policy, methodology, terminology, processes, and technology to support exercise planning, design, development, conduct, evaluation, and improvement planning. It is envisioned that the HSEEP-EP will provide capabilities that will span the wide spectrum of needs of a diverse set of stakeholders from Federal, state, local, and tribal governments, as well as non-governmental organizations and the private sector as appropriate. As such, widespread accessibility, information security, and ease of use and collaboration are important attributes of the technology platform. The system should enable more efficient and effective execution throughout the exercise life cycle. The inclusion of science-based modeling and simulation capabilities in the exercise process is a specific objective that will result in more realistic exercises. It is also recognized that as technology continues to advance, there will be opportunities to improve the exercise system and its capabilities; therefore, flexibility and extensibility are important architectural goals. Finally, technology transition to operational use is a key objective.

B. *Approach*

This program will utilize a spiral development approach which includes: (1) requirements analysis with stakeholder participation; (2) iterative design, development, prototyping, and demonstration of the HSEEP-EP architecture; and (3) integration of M&S capabilities into HSEEP-EP. The requirements development up front will facilitate stakeholder interest and buy-in. The architecture development effort will include a reference implementation of the HSEEP-EP, along with select capability prototypes where technology gaps exist. Existing technologies

will be incorporated into the architecture where practical. The spiral development approach will provide opportunities to obtain user feedback, adjust course as necessary, and potentially enable early transition of system components to operational use. The M&S integration effort includes both integration of the use of M&S into the HSEEP process and also integration of M&S tools into the HSEEP-EP.

III. System Requirements

The Department of Homeland Security (DHS) Science & Technology (S&T) Directorate sponsored HSEEP stakeholder interviews to collect system requirements for HSEEP-EP. In these interviews, federal, state, local, tribal and private entity stakeholder perspectives on the existing capabilities as well as future capabilities were identified. Upon completion, DHS S&T and the Federal Emergency Management Agency, National Exercise Division, conducted a workshop with select exercise planners from multiple agencies across the country to discuss, validate, and rank the system requirements in order of priority for possible HSEEP-EP inclusion. The HSEEP-EP requirements gathering is an ongoing, iterative process to conclude with a comprehensive list of operational and system requirements and policy recommendations.

IV. System Architecture Vision

Given the initial system requirements, new system architecture is required to implement HSEEP-EP that 1) enables a flexible and scalable framework for integrating new features and capabilities, 2) provides capabilities across the entirety of the exercise life cycle, and 3) promotes efficient archiving and exploitation of exercise data and information.

As seen in Figure 2, The HSEEP-EP architecture is being designed using an open, service-oriented architecture. A service-oriented architecture relies on the use of loosely coupled software services that can be orchestrated to create higher order functionality. Essentially, this creates a modular architecture, which provides greater flexibility, scalability, and interoperability than traditional monolithic software architectures. Additionally, the architecture can be made 'open' by relying upon standardized, non-proprietary interfaces and protocols in the design of the services. An open architecture is generally more conducive to an evolutionary growth because technology insertion, component upgrades, and external integration are easier. This type of architecture will provide the foundation HSEEP-EP to evolve as a robust system that can support a wide variety of exercises.

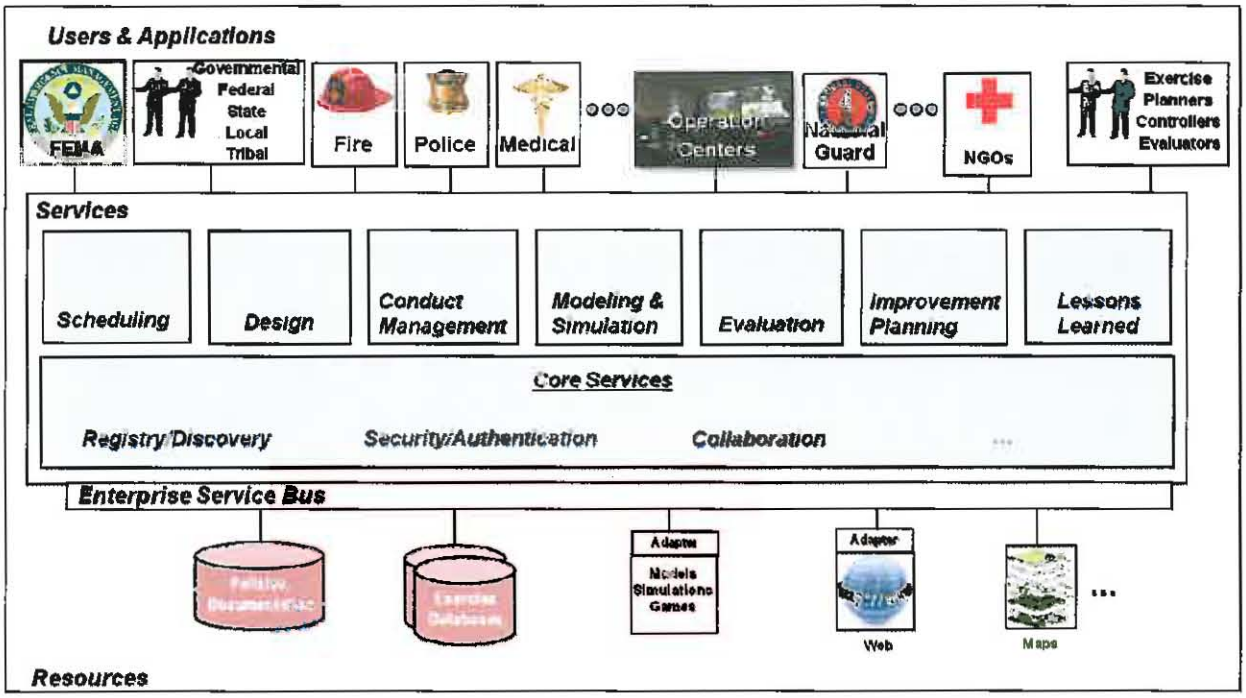

Figure 2. HSEEP-EP generic architecture.

To provide functionality across the exercise life cycle, HSEEP-EP will provide users with a single portal that supports exercise planning, design, conduct, evaluation, and improvement planning. Two focus areas for HSEEP-EP are exercise conduct and exercise evaluation. Currently, there are few tools and capabilities within the existing HSEEP tool kit that offer support to exercise planners within these areas. For example, with exercise conduct, applications are being developed within the HSEEP-EP architecture to generate and provide situational awareness of exercise progress. In addition to the development of new tools, HSEEP-EP will provide continuity by providing a single sign-on with role based access to HSEEP tools and exercise materials and structured site navigations that can be used to lead novice users through the exercise process.

While the activities associated with each stage of an exercise can vary, efficiency can be gained by properly archiving and exploiting exercise related information through the progression of an exercise. For example, exercise objectives are usually created and refined during the planning stage, but should be referenced heavily throughout the preceding stages. HSEEP-EP will contain a detailed model of the information and associated relationships, which will greatly enhance the user's ability to reuse and exploit information.

V. Integration of Modeling and Simulation Capabilities

An analysis was conducted to determine how modeling and simulation can be inserted into the HSEEP program management and exercise lifecycle, given new tools to support modeling and simulation. The use of modeling and simulation and its impact will vary in each of these phases. Figure 3 shows the insertion points of M&S into the HSEEP cycle, which will be discussed in each phase.

A. Strategy Planning

During strategy planning (red in Figure 3), exercise planning teams are setting the foundation for a multi-year exercise program. During this phase, planners can browse existing simulation templates by various search criteria including hazard, National Planning Scenario [4], or exercise objectives in order to determine how modeling and simulation can be utilized to deliver a science-based complexity to both discussion-based and operations-based exercises. Additionally, exercise planners can also review modeling results of previous exercises.

B. Design and Development

During design and development (orange in Figure 3), exercise planners can search for specific templates, and configure and run templates in order to fully develop a detailed scenario. During this phase, an exercise planner may configure the same template with different models or rerun the same template with varied inputs in order to generate ground truth data and the MSEL. Planning teams can run a number of "what if" scenarios by applying science-based analysis. Exercise planners can create quantitative injects, based on science-based models. Furthermore, exercise planners can use data visualization and graphical and tabular visualization of M&S results to refine and vet scenario and ground truth data with other exercise stakeholders.

C. Conduct

During exercise conduct (yellow in Figure 3) exercise controllers can use M&S to update the MSEL and recalculate real-time injects if exercise events and player decisions alter the scenario. M&S can also be used to do some real-time predicting during an exercise and assist the decision makers (i.e., players) during an exercise. Models can be run to provide on-demand injects and alter ground truth during an exercise, as needed.

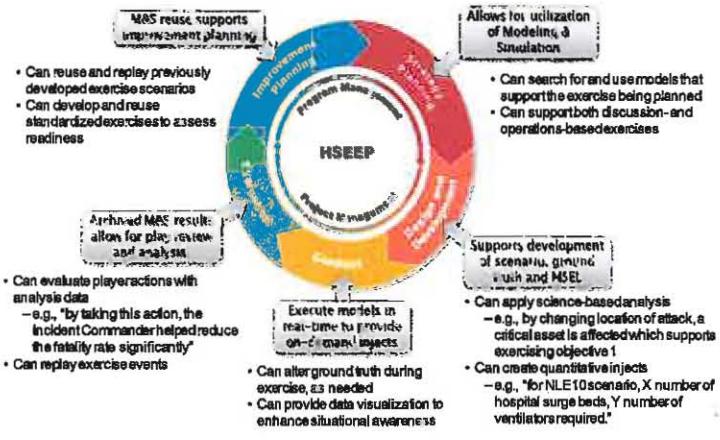

Figure 3. Insertion Points of Modeling and Simulation into HSEEP Cycle.

Data visualization of simulation results can be utilized by the exercise controllers/evaluators and simulators to give a common operating picture of the exercise scenario and events. Data visualization of results can also be used by exercise players to provide situational awareness; for example, exercise players may view simulated data, distributed to portable devices so that boots-on-the-ground players can see the exercise-simulated world, which is difficult and costly to produce.

D. Evaluation

During evaluation (green in Figure 3) evaluators can use M&S tools to analyze the expected versus actual performance and which best practices could be adopted. Evaluators can use archived modeling results to review player actions with analysis data. Evaluators can use data visualization to replay exercise events. At the end of an exercise and during the post analysis, models can be run to predict longer-term effects, e.g. economic impact, infrastructure issues, etc. This may require discovering different simulation templates and executing different modeling tools than were used during the planning and/or execution of an exercise.

E. Improvement Planning

Finally, during improvement planning (blue in Figure 3) exercise planners and evaluators can reuse and replay previously developed exercise scenarios developed with M&S in order to provide feedback to the longer term exercise planning process. Also, during this stage, teams can develop and reuse a set of standardized exercises that stress a response team and allow planners to continually assess readiness over time. By reusing and replaying previous exercises, exercises may gradually become standardized partly or wholly, which would enable assessment of national readiness across standard objectives.

VI. Conclusions and Future Work

An extensive and ongoing requirements gathering process for the HSEEP-Enterprise Platform is being conducted to derive operational and system requirements. Given initial system requirements, HSEEP-EP architecture is being designed and prototyped to support local, state, regional and national level exercises. The initial focus of the architecture includes support for exercise conduct, exercise evaluation, and the introduction of science-based modeling and simulation tools into the HSEEP cycle.

Realizing the opportunities to enhance exercises and planning through modeling and simulation, the DHS S&T is spearheading the Integrated Mapping, Modeling and Simulation (IMMS) program.[1] IMMS is a research and development effort to develop a common framework for integrating incident-related M&S tools for exercise and operations activities. SUMMIT, a software framework produced under IMMS, connects users such as emergency planners and exercise developers with modeling resources, bridging the gap in expertise and technical skills between these two communities. [5-7] This is one example of the type of M&S capabilities that will be included in the HSEEP-EP.

HSEEP-EP will continue to evolve as additional system requirements are gathered by engaging stakeholders and using the prototype tools to support exercise planning and conduct.

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